

\$2.00 US

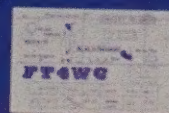
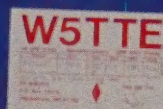
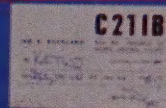
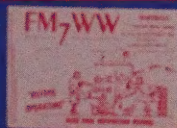
The Amateur Radio

COMMUNICATOR

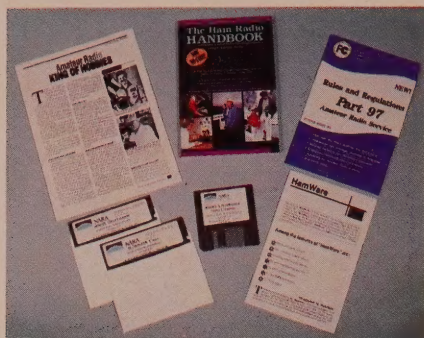
SEPTEMBER/OCTOBER 1992

Volume 2 Number 5

- *The NARA PR-1000 Award*
- *VHF and Repeaters*
- *Circuit Components*
- *Fun with Keys and Code*
- *Digital Communications*



AVAILABLE FROM NARA



Pass The New Codeless Technician Test!

Everything you need to pass the new codeless Technician Class exam! The **NARA Codeless Technician Package** includes:

- The Ham Radio Handbook, the 200+page study guide that guarantees you'll pass the test or your money back!
- HamWare software for testing your knowledge
- FCC Amateur Rules and Regulations book
- Bonus Morse code training program (IBM) 0 to 25wpm
- Complete list of Contact Volunteer Examiners
- King of Hobbies publication, a special introduction to Amateur radio

The **NARA Codeless Technician Package** (IBM) is just **\$29.95 (\$3.00 S&H) #P110**.

SALE!

Having Trouble with Code?

The Morse Academy, the latest version, IBM software, actually teaches all 43 required code characters and then steps you up through the Amateur Extra level using sophisticated computer aided instruction techniques. Adjustable tone, standard or Farnsworth spacing. Sends text or randomly generated characters—plus a 40-page on-disk manual! (5 1/4" disk) **WAS \$14.95, NOW ONLY \$9.95 (\$1.50 S&H) #S410**.

NEW!

Amateur Radio Mail Order Catalog And Resource Directory

This highly valuable reference directory contains over 1,500

entries, in 185 categories of Amateur radio resources! You'll find names, addresses and phone numbers on everything from Alternative energy to Zener diodes. Including parts and equipment, kits and keyers, even personalized hats, mugs and license plates. There is even an extensive listing of radio clubs worldwide, international radio magazines, and over 100 free catalogs available.

If you're looking for that hard-to-find antenna or the perfect gift for that ham in your life, it's all right here at your fingertips in this 236-page Amateur radio resource catalog. An absolute must for every Amateur to own! **Amateur Radio Mail Order Catalog and Resource Directory** is only **\$12.00 (\$3.00 S&H) #B660**

HamWare™ Testing Software

The HamWare, IBM compatible (5 1/4" and 3 1/2" disks) testing software, provides all the practice you need to get your first license or to upgrade. Drawings and diagrams appear automatically on screen along with the appropriate questions, and there's even a practice mode, complete with hints, answers and help screens. There's even a handy on-screen scientific calculator. Your choices are mouse or keyboard selectable. As a bonus, each disk includes a copy of Morse software for learning Morse code.

- HamWare Nov/Tech Classes w/Morse #S210
- HamWare General Class w/Morse #S211
- HamWare Advanced Class w/Morse #S212
- HamWare Extra Class w/Morse #S213

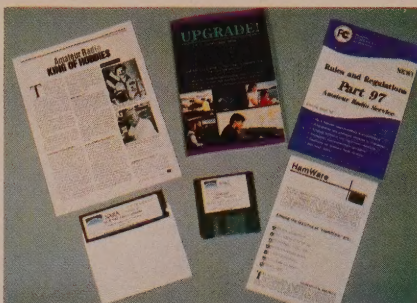
HamWare is available at Amateur Radio dealers or directly from NARA. License classes are sold individually. Each class is only **\$14.95 (\$2.00 S&H)**.

NARA Amateur Training Package

Start with your Novice or no-code Technician license and go "all the way" to Extra class with this excellent IBM compatible training package that includes:

- HamWare Novice/Technician Classes w/Morse
- HamWare General Class w/Morse
- HamWare Advanced Class w/Morse
- HamWare Extra Class w/Morse
- Ham radio FCC Rules and Regulations, Part 97
- Amateur Radio—King of Hobbies
- An extensive list of Contact Volunteer Examiners.

Save by ordering the **NARA Training Package**. This entire package (5 1/4" and 3 1/2" disks) is only **\$32.95 (\$3.00 S&H) #S220**.



Upgrade To General Class with the NARA Upgrade Package

NARA has put together all the essential tools you'll need to upgrade to General class. This value-packed offer includes:

- UPGRADE! book by Donald L. Stoner, W6TNS
- HamWare General Class IBM (5 1/4" and 3 1/2" disk) testing software w/Morse
- Ham radio FCC Rules and Regulations, Part 97
- Amateur Radio—King of Hobbies
- An extensive list of Contact Volunteer Examiners

The **NARA Upgrade Package** is available at Amateur Radio equipment dealers or directly from NARA for only **\$29.95 (\$3.00 S&H) #P240**.

A FREE issue of The Amateur Radio Communicator will be sent to you when you order any product from NARA! Your magazine will be mailed at a later date.

MacHam™ Testing Software

MacHam is one of the most elegant and useful series of Amateur radio programs ever written for the "Mac." All required circuit diagrams are displayed with the question right on the screen. If the test is printed, the diagrams are included.

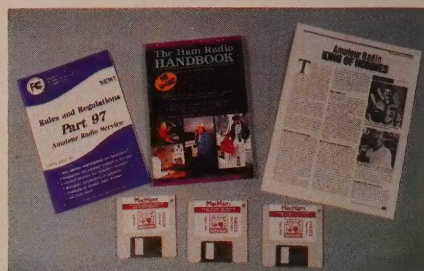
The tests can be taken on screen, by element or by chapter, with options of immediate or end-test scoring. Printouts create exact VE style exams, with question pool numbers, correct answer key and blank answer sheets as desired.

There is even an on-line glossary of terms. If you don't understand a word, simply look it up!

Choose from the following:

- MacHam Nov/Tech #S310 **\$39.95 (\$2.00 S&H)**
- MacHam General #S311 **\$29.95 (\$2.00 S&H)**
- MacHam Advanced #S312 **\$29.95 (\$2.00 S&H)**
- MacHam Extra #S313 **\$29.95 (\$2.00 S&H)**

System requirements: Any Macintosh computer, Mac Plus or newer, 2MB RAM with hard drive and Mac compatible printer. Fully compatible with System 7.0 and 6.0.7; ships with HyperCard 2.1 on two 3 1/2" 800K disks.



Pass the Codeless Technician Test with the MacHam™ Education Package

The **MacHam Education Package** includes:

- MacHam Novice/Technician Class Software
- Ham Radio Handbook, by Donald Stoner, W6TNS
- Ham radio FCC Rules and Regulations, Part 97
- Amateur Radio—King of Hobbies
- An extensive list of Contact Volunteer Examiners

Order direct from NARA today. The **MacHam Education Package** is only **\$49.95 (\$3.00 S&H) #P320**.

Upgrade to General with the MacHam™ Upgrade Package

If you want to upgrade to General Class, you need the **MacHam Upgrade Package** which includes:

- MacHam General Class software
- UPGRADE! book by Donald L. Stoner, W6TNS
- Ham radio FCC Rules and Regulations, Part 97
- Amateur Radio—King of Hobbies
- An extensive list of Contact Volunteer Examiners

The **MacHam Upgrade Package** is only **\$44.95 (\$3.00 S&H) #P340**.

Practice The Code With These Outstanding Code Tapes!

These tapes will help give you the practice you need to pass your code exams. Each set contains two cassette tapes.

- Novice/Technician Class 0 to 5wpm #T710.
- General Class 5 to 14wpm #T720
- Extra Class 12 to 24wpm #T730.

Order your set today for only **\$11.95 (\$2.00 S&H)**.

For The Fastest Service, Call NARA At 1-800-GOT-2-HAM (1-800-468-2426)

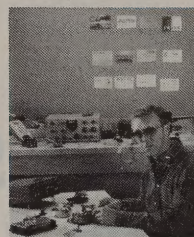
FEATURES

- 3 **The Future of the Hobby**
- 4 **How To Earn the NARA PR-1000 Award**
- 5 **Letters**
- 7 **How To Get Started in Packet Radio Book Review**
- 8 **How To Have Fun With Morse**
by Dave Ingram, K4TWJ
Fun With Keys and Code
- 14 **Repeater Etiquette**
by Phil Usher, KM6AA
Questions About Repeaters That You've Wanted To Ask

DEPARTMENTS

- 2 **In My Opinion**
by Don Stoner, W6TNS
Editorial
- 6 **How To Understand Ham Radio Theory**
by Terry R. Dettman, WX7S
Circuit Components
- 10 **How To Understand The World Of Ham Radio**
by Fred Maia, W5YI
Sorting Out Digital Communications
- 12 **How To Operate On VHF And Repeaters**
by Gordon West, WB6NOA
Weather Conditions Bring 2-Meter Super Range

ON THE COVER



THERE IS A SPECIAL glamor in telegraph keys which appeal to Amateurs of all license classes. Key collector Dave Ingram, K4TWJ, owns examples that represent the oldest and newest, smallest and

largest, and the three main styles of keys. For you nostalgia buffs, that rig in the background is a Collins KWM-1, which helped popularize SSB back in the 1960s. Compare that with the newest Icom HF SSB transceiver, the IC-729 in the foreground. Photo by Joe Veras, N4QB.

The Amateur Radio Communicator

The Amateur Radio Communicator is published bi-monthly and is the official journal of the National Amateur Radio Association (NARA), P.O. Box 598, Redmond, WA 98073-0598.

The National Amateur Radio Association is incorporated in the State of Washington and is a non-profit organization as defined in Section 501(c)(3) of the Internal Revenue Service Code.

Organization Goals

The broad goal of NARA is to publicize Amateur Radio and to encourage people to become Amateurs by earning an entry level Novice or Technician Class license.

The organization has five specific goals within this broad framework. These are to a) publicize Amateur Radio to the general public, b) attract young people to the Amateur Radio Service, c) increase the stature and benefits of the Novice and Technician Class licenses, d) represent the interests of Novice and Technician Class Amateurs at the national level and e) make all Amateurs aware that our radio frequencies are in jeopardy from commercial interests. More specifically:

A. NARA advertises in various consumer publications to create public awareness of the Amateur Radio Service.

B. NARA is specifically interested in encouraging young people to join our fraternity. A core of young people

insures growth of the Amateur Radio Service.

C. NARA believes that the Novice and Technician classes are important and respected entry level licenses into the Amateur Radio fraternity. We are committed to increasing its benefits and stature in the Amateur Radio community.

D. NARA is committed to representing the interests of all Novice and Technician Class Amateurs at the national level. We continue to review information from the Federal Communications Commission and submit material to them with the Novice and Technician perspective in mind.

E. Finally, NARA is very concerned that confiscation of frequencies assigned to the Amateur Radio Service will continue. NARA is committed to obtaining new spectrum for the continued growth in numbers of Novice and Technician Class Amateurs.

Membership and Subscriptions

Those joining NARA receive a subscription to *The Amateur Radio Communicator* for a period of one year. The combined cost of membership and magazine is \$10.00 per year in all areas with a U.S. ZIP code.

The NARA membership and subscription to *The Amateur Radio Communicator* cannot be separated.

It is not necessary to hold an

Amateur Radio license to become a member of the National Amateur Radio Association. The only "qualification" is an interest in radio communications.

How To Contact NARA

National Amateur Radio Association
P.O. Box 598

Redmond, WA 98073-0598

Inquiries (206)869-8052

Orders only .. 1(800)GOT-2-HAM
1(800)468-2426

FAX (206)861-5780

MCI Mailbox NARANET1

CompuServe 76702,753

Prodigy MMVT95A

America Online W6TNS DON

Editor/Publisher Donald L. Stoner, W6TNS

Vice President Bill Everett, K7RIE

General Manager Elizabeth Tackett, N7WIQ

Marketing George Ure, AC7X

Technical Editor Terry Dettmann, WX7S

News Editor Fred Maia, W5YI

VHF Editor Gordon West, WB6NOA

Technical Advisor Dan Lewis, N7NQL

Programing Olan Hanley, KB7GIS

Publication Deb Davis Bundy, N7IHY

Finance Lucy Heenan

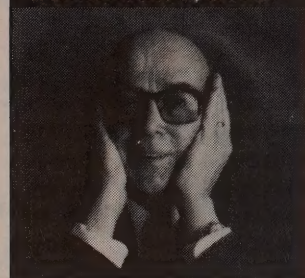


NARA

NATIONAL AMATEUR RADIO ASSOCIATION

P.O. Box 598

Redmond, WA 98073-0598



Don't Say We Didn't Warn You!!

by Don Stoner, W6TNS

AS I WAS SITTING here ruminating about the status of Novice and Technician Amateurs, I received a wonderful letter from Harry Helms, AA6FW. Harry, as you may recall, is the author of that great book *All About Ham Radio* (plug- it's available from NARA and most dealers).

Harry expressed my thoughts so eloquently that I requested permission to pass along his words on the status of Novice and Technician class hams. He writes:

"I'm very glad to see you are addressing the discrimination that too many codeless licensees are experiencing. If my listening and what people are telling me is any indication, it's getting worse. What we're seeing in such activity is not connected to anything having to do with the quality of ham radio or maintaining its standards; it is purely territorial behavior by a group of burned out and often bitter types who are unable to cope with change and are thus reflexively opposed to it. WA4D's remark about the codeless Tech being an 'Amateur Radio affirmative action plan' is really revealing; he's clearly not opposed to the codeless Tech on its merits or demerits but only because it's a change from an established order he's comfortable with.

However, hams are no different than other technically-oriented individuals in their remarkable frequent

inability to cope with change. This is surprising, since you would expect such people to be more objective, less emotional, and more rational in their approach to reality. Yet the American electronics industry is littered with people and companies that didn't realize that a storm was coming and got blown away. Remember Sylvania and what a force they were in vacuum tubes? They totally missed the solid-state revolution. Remember RCA and their racks of transistors in parts stores? RCA sat back and let young aggressive companies like Intel have the microprocessor business all to themselves.

But the point is,
change comes whether
you like it or not,
and you had better read
the wind correctly and
be prepared to react.

Organizations can successfully adapt to change. Take a look at Motorola. They started out making auto radios using vacuum tubes. They embraced solid-state when it hit and today still have a commanding presence in RF-power transistors. When Japan mounted a strong challenge to its consumer electronics

business, Motorola didn't try to fight a war they knew they would lose. Instead, they moved on to microprocessors and cellular telephony, and today beat the crap out of the Japanese in both areas.

But the point is, change comes whether you like it or not, and you had better read the wind correctly and be prepared to react.

That's where ham radio and established groups are totally missing the boat. I'm sitting here with the latest *W5YT Report* and it's clear that the codeless Tech is the entry point into ham radio today. Take a look at the figures for January 1992: 4,030 new hams, of which 655 received a Novice ticket, 3,318 the Tech, and the other 57 another license class. Since the codeless Tech was introduced, it's about a 3:1 ratio of new Techs to Novices. If—as it should be—the Novice is placed under the VEC system, you're going to see the number of Novices really drop. (It would be interesting to see how many Novices upgrade to just Tech-Plus compared to other license classes; I don't have the data.) However one wants to interpret the data since the first codeless Tech tickets were issued in March 1991, the trend is clear: before long the majority of active hams—and soon afterwards, a numerical majority—will be codeless Techs.

Outside of NARA, I don't see a single organization prepared to cope with the reality or even acknowledge it. Not everyone is as open as WA4D in their opposition; it is usually more

subtle. But, it is there. It shows in everything from codeless Techs being less-than-welcome at local radio clubs ("Gee, why don't you learn code so you can get on HF and really have fun?") to the fact that you would never guess that a codeless ham license is available from reading a typical issue of QST or CQ. Such people are kidding themselves. If no-code Techs are shut out from the existing mainstream, then they will form their own groups that might well become the mainstream of the future."

While NARA is certainly not declaring war on the established Amateur Radio structure, we have no intention of joining Sylvania, Hallicrafters, National, and dozens of other organizations that refused to adapt. Don't say we didn't warn you.

THE NOVICE AND VE TESTING

Harry touched on one subject that I wanted to mention this month and that is Novice testing by Volunteer Examiners. Due to budget constraints, in the early 1980s, the FCC privatized ham testing. Senator Barry Goldwater, K7UGA, the nation's highest-ranking ham operator, played a very important part in establishing testing by VECs. The volunteer Novice testing program was already in place. K7UGA's objective was to allow testing of all Amateur Radio operators by volunteers who held senior licenses. Thus the VEC System was born. It was the right idea for the right time. The Volunteer Examiner Program had no track record and the Novice license class was the main entry for beginners into our ranks.

But things have changed in the past 10 years. The Volunteer Examiner Program has been wildly successful. Even the FCC says so. Sadly, the morals and ethics of Americans has slipped a few notches since the early 80s. Clearly there has been cheating in the two-ham Novice examination program.

A few years ago, I was one of two hams that tested the young son of a third ham. A few weeks after the exam and submission of the forms, I received a note from the FCC. "Did I really conduct this exam? Was everything on the 'up and up' with the application?" It was, and I thanked the Commission by letter for being so diligent. But I realized later that this should have been totally unnecessary. It was certainly a lot of extra work for them.

"The Novice exams are now in the process of being folded into the VEC System and we at NARA applaud the move. In my opinion, VEC coordination increases the stature and importance of the Novice class license, is more business-like and most importantly, provides a chain of command from the FCC to the VE. This is lacking in the present Novice testing program since the FCC no longer is involved in any Amateur testing program of any kind. It is all handled by the VECs with whom the FCC exclusively deals.

The VECs Question Pool Committee also develops and revises all Novice test questions. It makes sense that it should also supervise test administration. Due to frequent Part 97 rule changes, the VECs must adjust the questions accordingly. And

the VEC System is perceived as a more credible program. When you tell someone you are a Novice, you need not worry if they are thinking, "I wonder if his mom or dad helped him get his license."

73 Don, W6TNS

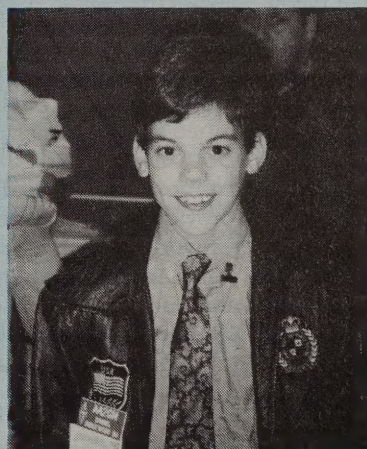
□

THE FUTURE OF OUR HOBBY!

This month's featured ham is 11-year-old Daniel Savio, AA2GM, of Ridgewood, New Jersey. I met Daniel at the 1992 *Dayton Hamvention* and was very impressed by the ham radio knowledge of this young man (not to mention that he was better dressed than I!).

de W6TNS

□



HOW DID I GET THIS MAGAZINE?

ONE OF THE WAYS WE CAN TELL THE WORLD ABOUT THE GOALS and ambitions of the National Amateur Radio Association is to supply complimentary copies. We send about 10,000 pieces to newly licensed hams. This magazine is also mailed to a select list of people who might be interested in becoming Amateurs. We also send approximately 10,000 copies to NARA members and prominent people in Amateur Radio.

If your mailing label does not include a NARA membership number, this may be your last or only copy of *The Amateur Radio Communicator*. We would like to continue providing you with this informative publication, but we can only do so if you are a

member of NARA. For those interested in becoming a ham, or who are newly licensed, a membership in NARA represents an outstanding bargain. A membership, which includes a subscription to *The Amateur Radio Communicator*, is only \$10.00 per year.

Check the mailing label for your membership number. If you don't see one, look at the NARA advertisement and read the benefits of becoming a member of this fast-growing organization. We need your support and so does ham radio. Help us get it "going and growing!"

INTRODUCING!

The NARA PR-1000 Award

AS MENTIONED IN *THE Amateur Radio Communicator*, we're very proud to announce the availability of the new **NARA PR-1000** certificate and plaque awards.

A much greater public awareness of the Amateur Radio Service is necessary if we're to maintain our strong history of service to the public. Indeed, given that public (and Congressional) awareness of the good things that we Amateurs succeed in doing for the public on a daily basis, *must* be continued, NARA believes that the *PR-1000 award* will go a long way toward those worthy goals.

This award provides well-deserved recognition for anyone! Whether you are a licensed radio Amateur holding any class of Amateur Radio license, a shortwave listener (SWL), or any other individual capable of proving Amateur Radio public relations success with the media.

To earn the PR-1000 award, proof must be supplied to the NARA Awards Committee showing no less

than five newspaper articles, or TV/commercial (AM/FM) radio transcripts, for which the applicant was directly responsible.

Some helpful hints on how the PR-1000 award might be earned:

1. Create, submit and succeed in getting published a brief write-up to five local newspapers of your Amateur Radio club's public service activities. Or, if you like, convince the newspaper's Editor to publish your article or news brief once a month for five months. Any combination works.

2. Arrange with your local cable or broadcast TV station to show Amateur Radio Public Service Announcements (PSAs) or even one or more of the many Amateur Radio movies that are now available. One movie or PSA, shown five times, qualifies you for the award. Many such movies and PSAs are available for free loan by contacting the Media Service, The National Amateur Radio Association and the Educational Activities Department of the ARRL headquarters in Newington, Connecticut.

3. Arrange to have AM/FM commercial-radio stations announce five or more times the fact that Amateur Radio operators were responsible for emergency communications in the aftermath of a local disaster—regardless of the size or impact of the event.

4. Convince five radio, TV, or newspaper outlets to mention the efforts of your local Volunteer Examiners, test sessions, traffic-handling booths at local malls, county fairs or emergency communications preparedness

activities by your local ARES/RACES groups.

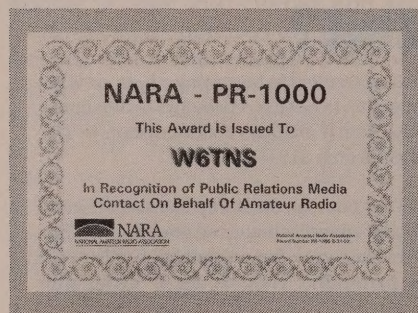
We're certain that you'll think of many other possible opportunities to show the good deeds of the Amateur Radio Service to media outlets in your locality. Be resourceful!

To obtain the very beautiful NARA *PR-1000* certificate or plaque, you must submit proof that the media outlets utilized five of your submissions, or any combination totalling five uses of your material, or material provided by you. We're sure you'll find the NARA Awards Committee to be very flexible and understanding, but the decisions of the awards committee are final, so if in doubt, we suggest that an extra submission or two be included, just to be safe.

Finally, if you're having difficulty proving that a particular media use of your material was in fact the result of your efforts, the NARA Awards Committee will accept a signed statement from you to that effect.

As is the case with each of the NARA awards, the *PR-1000* is available in both certificate and plaque formats. In addition, beautiful gold-leaf endorsement stickers are available for media contacts over and above the basic five, in increments of five.

We hope you're pleased with the NARA awards programs that have appeared here in *The Amateur Radio Communicator* these past few months, and we're always interested in suggestions that you may have for future awards. Please be sure to contact the NARA Awards Committee at



The PR-1000 Plaque/Certificate

the West Hartford, Connecticut address shown below for any awards program questions or comments you may have.

NARA PR-1000 applications and questions should be sent to:

NARA Awards Committee
104 Park Rd., Suite #6
West Hartford, CT 06119

Applications must contain the necessary proof of media contact and the \$10.00 fee for a certificate or \$35.00 fee for a plaque. Gold-leaf endorsements are available for only \$3.00 each. All portions of the application become the property of NARA and cannot be returned. Decisions of the NARA Awards Committee are final. Questions and suggestions about the NARA Awards Program are welcome. Self-addressed stamped envelopes are appreciated! □

HOT TIPS

No More Unattended HF Packet Messages!

The Amateur HF packet community is up-in-arms over the ARRL's refusal to recommend continuation of the FCC special authorization for automatically controlled HF packet operation. The STA (Special Temporary Authorization), in effect some six years, is scheduled to expire on January 8, 1993.

Thanks, W5YI Report

LETTERS

Teachers Say Thank You!

Thank you for sending the copies of your magazines. The students are going to love them. They are hungry for any information they can get their hands on. We have four Boy Scouts in the class. They are planning hikes and their ham shacks. The whole class participated in field day. It was a neat experience watching the kids go from being reluctant hams to being proficient and professional hams. Thanks for your support.

Gail Key, N7HFD
Samantha Smith Elementary
School, Redmond, Washington

I have been longing to let you people know how grateful we educators are to *The Amateur Radio Communicator*. We volunteer in five schools a week, handing the keys to the electronic kingdom to kids from 4th through 12th grade and your latest plan for an "exciting, vibrant, awards program." We are involved this year in trying to get school clearance for our high school hams to visit a nearby elementary school once or twice a week, during the free period. One of our 12th graders won the Hitachi Award of \$5,000 several years ago.

Bless you all at NARA. Keep directing our choir.

Mary Duffield
P.O. Box 3542
Santa Cruz, CA 95063-3542
(408) 425-8900

(If you are interested in teaching, ham radio and kids, contact Mary, who operates the Redwood Youth Foundation, for information- de W6TNS)

More Kind Words

Thanks for providing an alternate and hopefully leading voice for ham radio. If there is anything I can do to help strengthen NARA, please contact me!

73, Jim Fonte, KK9T

Catch 22.5

I have been a Tech for about one and one-half years. On June 6, 1992, I

passed my General written and code, got a certificate that says I am a General, and can use all the General frequencies with the "AG" suffix. I am still waiting for the license from the FCC. On July 13, 1992, I passed the Advanced written, got a certificate that says I am an Advanced ham and can use the frequencies with the "AA" suffix.

Two days later I received a pre-printed letter from the VEC saying that they cannot process my Advanced license until I give them a copy of my General license (that I am waiting for) and that I cannot use the Advanced frequencies or the "AA" suffix. The reason?—"The FCC will allow us to process only one application at a time for an applicant." Gee, 8-10 weeks per license. Now I know why most hams "of a higher class" are old duffs <GRIN>.

73, Kent Hufford

Help A Key Collector

I heard you were doing an article on keys, bugs and paddles. If you have a key, bug or paddle (especially paddles) that you are not using, give me a chance to add it to my collection. Call me in Phoenix at (602) 759-8019 or leave mail via packet radio: N6HI @ KB7TV.AZ USA.NA or write me at 4035 East Lavender Lane, Phoenix, AZ 85044-4681.

Thanks and 73, John L. Rehak,
N6HI

To Astronaut Jay Apt, N5QWL

Best wishes from all of us at The National Amateur Radio Association and our members, Jay. A question one of our readers asked me...when you are over the midwest United States and the craft is in the right attitude, can you see from Atlantic to Pacific at the mission altitude?

73, Don Stoner, W6TNS

The distance to the horizon from 163 nautical miles (nm)—our altitude on STS-47—is 1039 nm. You cannot see features much more than half that far, or so, depending on the amount of dust and haze. The highest altitude that the shuttle can reach is 330 nm, from where the horizon is 1451 nm away.

73, Jay Apt, N5QWL

Circuit Components

by Terry R. Dettmann, WX7S

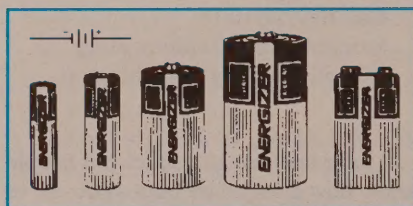
YOU CAN'T HAVE A radio without components. Radios are built from resistors, capacitors, transistors, and other "bits and pieces," all assembled together to perform the miracle of communications. Without components, we wouldn't have any Amateur radios to play with! In the years to come, components will be getting smaller and smaller as will the equipment they make. Even integrated circuits, now the heart of most electronics, are just these basic components at the microscopic level.

For many components, it can be useful to think about an electrical circuit like a pipe carrying water. Wires are the pipes that direct the 'water' (electrical current) around the circuit. Other components modify this flow in some way. They may increase the flow, decrease it, divert it, or whatever. Don't push this analogy too far, however. Electricity is *not* water! You might be surprised how many professional people use this as a way to think about electricity, however.

It all starts with some kind of source of electrical power. In our case, it is usually a battery or battery substitute such as a power supply.

Batteries

Batteries are **sources** of energy. In our water-flow example, batteries are like a big reservoir of water high up on a hill from which the water



Battery and schematic symbol

flows. As we use them, they eventually run dry.

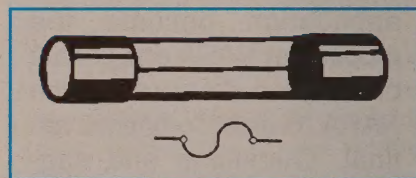
Batteries are marvels of technology, though we take them for granted. The most familiar type of battery is the **primary** or **non-rechargeable**. These are the familiar Alkaline cells most of us use in flashlights, transistor radios, and portable tape players. The second type of battery is the **rechargeable** or **storage** battery. You have one of these in your car. The common thing about all of these batteries is that they produce power by *chemical reactions*. Just *how* they work is an entire subject all in itself.

Any practical battery installation is usually one or more basic **cells**, connected together in series. Cells have a single, non-controllable voltage output. By connecting them together in series, we add the voltages to form a larger voltage in order to power a circuit. For example; two 1.5-volt batteries in series make one three-volt source of electrical power.

Fuses

Fuses are protective devices that keep high currents from harming valuable components in a circuit. In our water example, fuses would be

like a *water-relief valve*. If the pressure gets too high, the relief valve opens and lets the water out. A fuse works by opening the circuit it's protecting, to stop the flow of electricity.



Fuse and schematic symbol

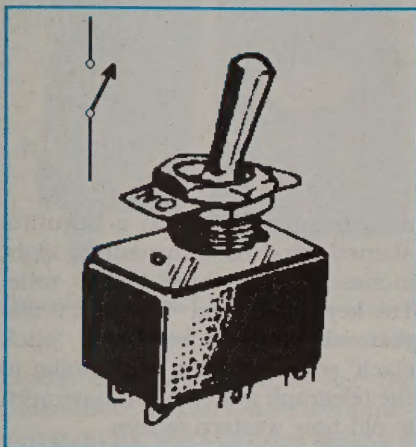
Fuses are small pieces of wire carefully chosen to melt when the current reaches a certain level. Current generates heat when it flows through the fuse. This heat is enough to melt the metal and open the circuit. Usually, **slow-blow** fuses are used for motor circuits (such as a blower fan) because a motor will draw a higher-than-normal *starting current* for a short time. **Fast-blow** fuses are used for low-power semiconductor circuits since the circuits are very sensitive to even slightly higher-than-normal currents.

Switches

Switches allow us to either turn a flow on and off (like a valve in a water pipe), or to divert it from one circuit to another. There are several terms used to describe switches that we need to know about:

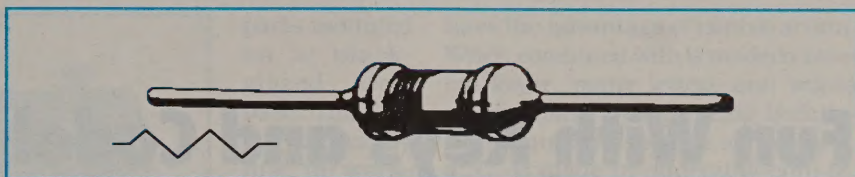
Pole - The number of connections to which the current can be directed. 'Single Pole' is an on/off switch while 'Double Pole' could go two ways.

Throw - The number of connections made by the switch. A 'Double Throw' would connect two current paths at the same time.



Switch and schematic

We can find switches in all possible combinations of these types and more. There are 'Single Pole, Single Throw,' 'Single Pole, Double Throw,'



Resistor and schematic

'Double Pole, Single Throw,' and 'Double Pole, Double Throw.' When we have more than two poles, we often use **'Rotary Switches.'**

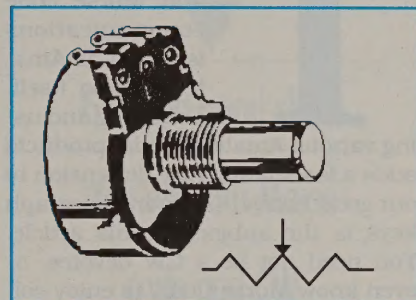
Resistors

Resistors drop the 'pressure' in our 'water line'. They dissipate some of the electrical energy in the flow. This drops the voltage level for whatever reason we choose. We put resistors in to get the right voltage at the place we want it.

Sometimes, we can use a fixed resistance in a circuit to achieve the desired result. Occasionally, the resistance has to be adjustable, and so we insert a variable resistor.

If you are interested in learning more about components, I'd suggest getting a basic book on electronics and working through the sections on electronic components.

Until next time, 73 Terry, WX7S □



Variable Resistor and schematic

HOW TO GET STARTED IN PACKET RADIO

Book Review by Don Stoner, W6TNS

According to Amateur Radio dealers, many questions they hear are about packet radio. Packet is one of the most exciting and rapidly expanding areas of ham radio. Most of the new Amateurs joining our hobby are somewhat familiar with computers. But some are unaware that it is possible to interface their CPUs to Amateur Radio equipment. With packet, they can have modem-like communications without tying up the phone line.

"What do I need? Who can I talk to? Does a packet rig really act like a digital repeater (digipeater)?" are just a few of the facts that inquiring minds want to know.

Dave Ingram, K4TWJ, has created his best book so far, called *How To Get Started In Packet Radio*. He answers these questions and many more. I particularly enjoy the way Dave explains complex subjects in simple terms. For example, he explains digipeating with

a comparison to passing notes in a school-building classroom. The analogy is technically correct and, at the same time, it is easy to visualize.

The "packet simplified" section includes the current status of packet and how to get started. One chapter is devoted to packet equipment (terminal node controllers—TNCs) and the ham radios they are used with.



Dave also covers setting up a station, operating packet and networking, along with portable and HF operation. Over 50 photos are in the

book, plus many drawings to simplify understanding the material discussed in the text.

Beginners will find the Appendix very helpful. It shows how to interface most TNCs with popular radios, including wiring diagrams.

How To Get Started In Packet Radio is available at ham radio dealers everywhere and is priced at \$9.95. If you plan on operating this fascinating mode, stop by a store and examine a copy. You'll see why NARA is so enthused by K4TWJ's new book. If your dealer doesn't stock it, *Packet Radio* can be ordered directly from NARA by adding \$2 shipping and handling.

By the way, we understand that Dave has installed a tape recorder along with his "Outbackin'" HF-mobile rig (see photo), and is dictating a new book called *"How To Get Started in QRP"* while he mows the "back 40." Stay tuned to NARA for more information. □

Fun With Keys and Code!

by Dave Ingram, K4TWJ

THE WORLD OF radio telegraphy and Morse code communications is as old as Amateur Radio itself. Collecting and using various Amateur Radio products adds a fascinating new dimension to our great hobby. Collecting telegraph keys is the subject of this article. You need not be a CW devotee, or even know Morse Code, to enjoy collecting these always popular Amateur Radio accessories. However, if you feel inclined to "let your fingers do the talking" with one or more favorite keys, the real pleasure of key collecting returns tenfold!

Operating CW

The joy of operating CW extends far beyond simple fun with basic-style equipment. CW reflects a proud skill acquired by its user and is a classic Amateur Radio tradition. Working DX is also easier on CW. A large number of foreign Amateurs prefer operating CW while a comparatively lower percentage of United States Amateurs work CW. Additionally, your rig delivers its full output power on each Morse letter transmitted rather than just on SSB-voice peaks. The use of Morse code and "Q" signals also sidesteps many language barriers so you can communicate with Amateurs in Russia, Germany, Japan, India, etc. . . , even if you do not speak their language. Start operating CW, and you too, will agree it is a terrific mode with a real communications advantage!

Collecting Telegraph Keys

Why is key collecting so popular among Amateurs? It is a natural pursuit anyone can enjoy regardless of

Amateur Radio license class or technical background. It is less expensive than collecting classic autos or rare paintings and keys are wonderful little pieces of history you can hold in your hand. Whether you work CW or not, every "ham shack" needs at least one key to reflect our proud heritage and link with past eras!

Generally speaking, there are three categories of keys: the traditional **hand** or **"pump" key**, the **semi-automatic key** or mechanical **"bug,"** and the modern-style **paddle** used with an electronic keyer. Hand keys and paddles are readily available in a glamorous variety of styles today. The "bug" was the ultimate reflection of a Morse "pro." In the last decade, keyers have all but replaced bugs. Only two models remain in production at this time.

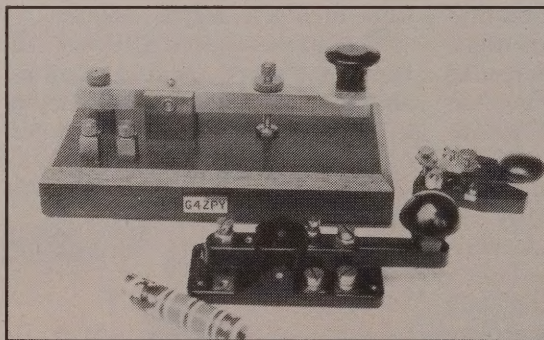


Figure 1. Three interesting varieties of hand keys.

Figure 1 shows three interesting varieties of basic-style hand keys. The upper and largest item is a new "kit key" available today from G4ZPY in England. The key comes 80 percent completed, so assembly is a 15-minute job. The key's mechanism is made of highly-polished brass with fine race bearings at the fulcrum and precision thread screws for

adjustments. It sits on a beautiful stained-wood base measuring eight inches long by three inches wide. The key has a good "feel" and it fills your shack with romantic "click clack" sounds during use, similar to the telegraph systems you have seen in old-time western movies.

The lower item is a British Army key rescued from a WWII tank. It is 80-percent plastic and sports a mushroom-type knob. This key is exceptionally well-balanced and handles great. Notice the binding posts for these two British keys are mounted on the left, whereas posts are usually on the right or rear of American keys.

The key on the right is one of my favorite items for portable QRP operation. It is a Japanese "spy key" measuring only two inches long. This delight was a gift from fellow collector and CW aficionado, JN1GAD, and looks like a miniature version of the ever popular J-38 key. Use your pocket magnifier to look close and you will see there are tiny adjustment screws complete with locknuts on the key's front, rear, and sides. A knob that looks like a Junior Mint complements this key.

This style knob is quite popular in keys from the Far East. Miniatures are great fun to use on-the-air, but finding even one of them is a super challenge.

Why is the ballpoint pen included in Figure 1? It is my own 350mw QRP transmitter! All circuitry, including a 12-volt battery and crystal, are inside the pen case. The push

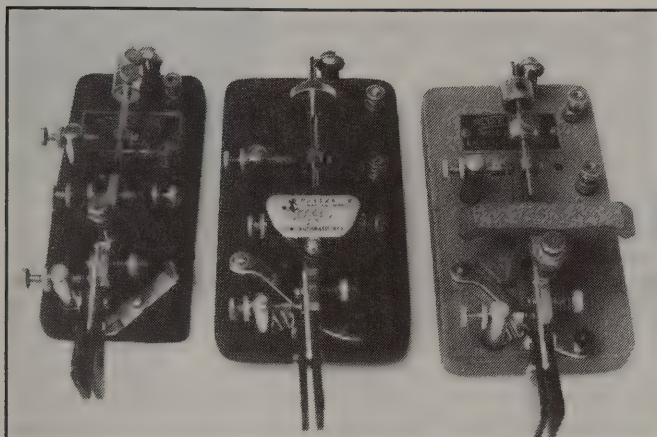


Figure 2. Three models of Speed-X bugs.

button on top is used to key the transmitter, and an antenna connection is on the pen's bottom. Believe it or not, this pen rig has been used to contact over four countries! Details of this tiny transmitter are included in my upcoming book, *How To Get Started In QRP*, to be published by NARA in the near future.

In *Figure 2*, you can see three classic semi-automatic bugs that I use on-the-air almost daily. The left item is a Speed-X Model 510 made by the Les Logan Company in San Francisco during the 1940s. The middle key is also a Speed-X, but it sports the famous E. F. Johnson Company nameplate. The right key is another Speed-X delight that really produces beautiful-sounding Morse when handled properly.

At this point, I must emphasize that a bug is not the perfect item for the CW newcomer. That is because you must manually make dashes and space characters by hand. Additionally, an incorrectly adjusted bug sends choppy dots. Newcomers are urged to stick to hand keys or paddles used in conjunction with an electronic keyer.

Figure 3 shows two unique versions of paddles used with modern-electronic keyers. The left item is a single-lever paddle made (and available today) by G4ZPY. It has beautiful hand-polished brass

parts mounted on a black-glazed steel base. This key is extremely fine in workmanship with clearances of only one to three-thousandths of an inch. As a result, it is a mechanical "touch key." In other words, you simply touch ei-

ther side to produce dots and dashes and you cannot even feel the arm move. The touch of "magic" in using this paddle is beyond description. It almost feels like a dual-lever paddle or like it is sensing your fingers' movements. I have yet to find any single-lever paddle even remotely close to this gem. It is incredible!

The right paddle is a Schurr "Profi" model made in Germany and sold by DL7NS, Klaus Gramowski, Kaiserin-Augusta-Allee 91, D-1000 Berlin 10, Germany. Workmanship of this handmade paddle is also fantastic. Notice this item uses dual levers: the left one for dots and the right one for dashes. The upper parts are glazed copper with "zapperrung" finish. They are mounted on a steel and gray-painted base.

Now let's talk about the difference in paddles. Some CW operators prefer single-lever paddles because they will only move in one direction at a time. This makes sending CW easier for someone with "cumbersome fingers." Dual-lever paddles, however,

have the advantage of iambic action. When combined with a modern-iambic keyer, many letters and words can be made by squeezing both levers simultaneously. As an example, a "C" is made by squeezing both levers with the right (dash) lever leading. Squeezing both levers with the left side leading automatically produces a period. A variety of additional paddle styles are readily available today—I simply chose two unique items for this photo.



Give it a good shot—

You will find Morse

code and CW

operating a blast!

Every key collection is different and originally begins with only two or three keys an owner found appealing. Some collections are rather diverse and consist of 100 to 200 (or more) keys of different types. Some collectors specialize in only keys made in the United States by a particular company. Some consist of only a dozen genuine classics. Other collections consist of historical pump keys, bugs only, and some contain only keys purchased new today. In all cases, the deciding factor is what one likes or appreciates.

This discussion of keys and CW telegraphy could continue forever. If you're interested in reading more, refer to my book, *Keys-Keys-Keys*.

Indeed, it is a fascinating pursuit guaranteed to captivate one's interest for a full lifetime! We trust you found our views interesting and we have inspired your interest in operating CW. Give it a good shot—you will find Morse code and CW operating a blast!

73, Dave, K4TWJ

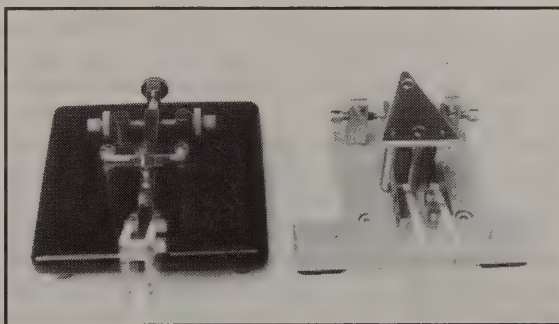
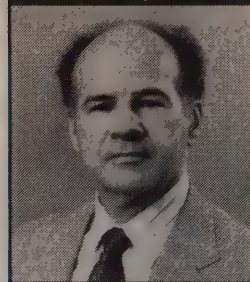


Figure 3. Two unique versions of paddles.



National Volunteer
Examiner Coordinator

Sorting Out Digital Communications

by Frederick O. Maia, W5YI

YOU HAVE MOST likely heard the words *analog* and *digital* in your travels through the world of Amateur Radio. This month, let's take an in-depth look at these two words and see if we can understand them better and how they apply to ham radio communications.

An electronic dictionary defines analog communications as having an electrical signal that varies in some direct way to non-electrical information. For example, the frequency or the magnitude of the signal may change in direct relation to sound.

Digital data uses different coded numbers or characters sent at high speed to indicate the variables of information. Analog data is a directly-changing voltage, frequency or other signal. To extract information from a digital signal you need to convert the sequences of numbers or characters to intelligence that can be understood. Analog signals are read by devices that can directly convert the signal voltage to intelligence—such as the speaker on a receiver.

As a general rule, digital radio signals can be sent more efficiently than analog modulation. The conversation or data stream can be divided into chunks and sent at specified times coordinated with a receiver that then reassembles the chunks of data into the whole conversation. Furthermore, you can interweave different conversations or data on the same frequency or wireline by interweaving

various "chunks" in a reproducible manner.

FROM MORSE CODE TO ASCII

Samuel F.B. Morse and his assistant, Alfred Vail, wanted to be able to transmit their telegraphic code as fast as possible. To reduce the time required, they decided the most frequently used letters of the alphabet should be indicated by the shortest possible sequences of dots and dashes.



Digital communications

is the future of

ham radio.

It always was.

Always will be.

They determined the most used letters by simply visiting a printer. The "E" became a dot, and the "T" became a dash when the printer's type case disclosed more Es and Ts were used than any other characters. The telegraphic code could now be transmitted at two characters a second; equal to 24 words-per-minute, or about 15 bits-per-second.

The first Amateur wireline and radio communications were both digital telegraphy. Less than a hundred years ago, Marconi spanned the Atlantic Ocean with continuous wave (CW) Morse code signals transmitted over-the-air from England to North America. It was sent by hand and received by ear.

Manual telegraphy was not the first instance of digital signalling, however. Converting on/off, yes/no, somethings/nothings and ones and zeros to understood information is as old as history itself. Jungle drums, flashing mirrors, bonfires and smoke signals are all primitive forms of digital communications.

THE BAUDOT CODE

The radio transmission of automated binary (radioteletype) communications followed in the 1940s and 50s. Depressing a typewriter-like key transmitted a series of five two-state (on-off) pulses (or data bits) rather than the three states (short, long and off) used in the Morse code.

The five-bit code was named for the 19th-century French telegrapher Emile Baudot who developed it in the 1870s. Each character on the keyboard is represented by a distinctive combination of five on-or-off signals, or bits.

His goal was to automate telegraphy. But the Baudot code had a serious shortcoming; five bits can only be combined in 32 ways—not enough for 26 letters and 10 numerals. Baudot's answer was to use the shift key to switch the machine from

alpha characters to numbers and punctuation (or the other way around).

Radioteletype revolutionized telegraphy! Now anyone could be a telegrapher by simply typing. Faster speeds of up to 75 WPM were possible by punching groups of five holes in paper tape and running the perforated tape through a tape reader. RTTY was state-of-the-art technology during World War II and the Korean conflict. It became the means of handling airline reservations, stock market quotations and even real estate listings. Teletypes, when fed to Linotype machines, automatically set the news in type. CW and RTTY however, had a similar problem, both worked perfectly over wirelines, but not so over the air. Radio signals were frequently damaged by noise, fading and interference. One way to combat the interference was to assign separate frequencies that represent the on-and-off states of the data bits. The *on* state or *one* is called the *mark*. The *off* state or *zero* is called the *space* signal. These signals are transmitted on two slightly different frequencies. This is called **frequency-shift keying**.

In 1953, the FCC authorized the Amateur use of this frequency-shift keying (FSK) scheme, which replaced the old on/off keying method. Most Amateurs used audio frequency-shift keying (AFSK), however, by feeding the tones into the microphone jack of their SSB transmitter. No one could tell the difference. Radioteletype remained the primary Amateur digital communication means for some three decades. Like Morse code, many hams still use radioteletype.

ASCII

In 1980, fueled by expanding use of personal computers, the FCC authorized the use of the 7-element ASCII code over the Amateur airwaves. ASCII, an acronym for the American National Standard Code for Information Interchange, allowed 128 different character combinations—enough for both lower and upper case letters, numerals, punctuation and a few special symbols. Two years

later the FCC decided to permit any digital code above 50 MHz at speeds up to 19.6 kilobauds.

The popularity of computers and modems in the 80s led to the development of sophisticated “computer patches” or **radio modems**. The technical name of these modems is the **terminal node controller** or **TNC** for short. Basically a terminal node controller assembles and disassembles *packets of information*. One big advantage to digital-data transfer by radio is that radio waves can carry information at no charge. Long-distance computer communications over telephone lines can be very expensive!

PACKET RADIO

The first **packet** networks were over telephone cable. Commercial packet radio appeared around 1970, and on the Canadian ham bands in 1978. It wasn't long before American ham publications began hailing its virtues. Packet was error-free and faster than RTTY. After a group of Amateurs fully tested the technology, packet radio was allowed on the United States ham bands in 1980.



A valuable feature of a packet
radio station is its ability to
serve as a digital repeater

The term *packet* refers to the system of arranging information into **fields** and **flags**. Each packet “chunk” (called a frame) is organized in a certain way, and among other things, contains address and (256 character) information fields. If the information exceeds 256 bytes, then another packet is sent down the line. Part of the frame consists of an error-checking field which causes an internal number to be generated which relates to the packet. Re-transmission is requested if the number and packet bits do not match up on

the receiving end.

The first ARRL *Computer Networking Conference* was held in 1981. One of its attendees returned to his home in Tucson, Arizona. The result was the formation of **TAPR**, the **Tucson Amateur Packet Radio Corporation**. They developed a low-cost TNC that used a packet standard they called **AX.25**. Actually, the AX.25 protocol is a modified version of the X.25 standard used for commercial data transmission over phone lines. The “A” stands for Amateur. By 1983, TAPR began distribution to Amateurs of its TNC in kit form. They sold some 2,500 kits. The ARRL Board of Directors approved the AX.25 format as the ham standard in 1984.

Packet radio began to become commonplace in the following years. Amateurs at the 1984 Summer Olympics in Los Angeles used packet stations to forward telephone messages. Packet messaging offered many advantages over traditional traffic handling, not the least of which, was that it was fast and error-free.

A valuable feature of a packet radio station is its ability to serve as a digital repeater—or **digipeater**. At their option, intermediate packet stations can store-and-forward packet messages not addressed to them. Since the retransmission does not take place until after receipt, only one channel is needed for both receiving and transmitting.

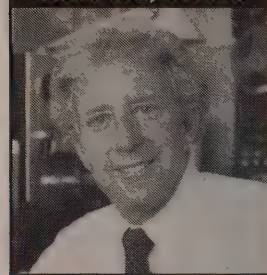
PACKET EQUIPMENT

Computer-to-computer ham radio is now one of the most popular forms of two-way error-free Amateur Radio communication. Hams use packet radio to chat, transfer files, send messages—even to span continents through orbiting satellites.

Digital communications is the future of ham radio. It always was. Always will be. Packet radio is really just getting started! So get in on communications history today!

73, Fred, W5YI

Fred Maia, W5YI
National Volunteer Examiner Coordinator
P.O. Box 565101
Dallas, Texas 75356



Weather Conditions Bring 2-Meter Super Range

by Gordon West, WB6NOA

On VHF and UHF bands, local weather can create some extremely long-range contacts.

WHEN YOU WERE studying for your new Technician class license, you probably remember five questions dealing with **tro-**

pospheric ducting. Now that you have your new license, you can get ready to enjoy some of the excitement when tropospheric-ducting conditions occur this fall on the 2-meter band.

Your 2-meter range is usually limited to about 100 miles when working through repeater stations. If you are running just a small handheld with a little "rubber duck" antenna, you might only get about 50 miles. But, if you run a big 45-watt mobile,

and an outside mobile antenna (or a 2-meter base station), you might enjoy repeater communications out to 150 miles.

Sunspots and ionospheric conditions don't affect the 2-meter band. Ionospheric fireworks are enjoyed by Novice and Technician-Plus operators when they operate voice on 10 meters, and CW on the high-frequency bands of 15, 40, and 80 meters. Here the ionosphere skips the signal back to earth, thousands of miles away.

On the 2-meter band, the radio wavelength is too short to skip off of any ionospheric layer. But, there's a situation on the VHF and UHF bands that provides super-range, and that is our local weather conditions. On the worldwide bands, localized weather conditions don't play a part on range. But on VHF and UHF bands, where you might now enjoy codeless Technician class privileges, local weather can create some extremely long-range contacts.

Chances are you have probably already experienced 2-meter "super-range." One day you turn on your radio, and there are repeaters coming in all over the band, some as far away as 300 to 500 miles! You place a call through these distant repeaters, and the other operators say they hear you loud and clear—over 400 miles distance! These conditions of enhanced 2-meter range could last for days.

The phenomena of long-range 2-meter contacts is technically called



Paul Lieb, KH6HME, record-holder for furthest tropo-ducting 2-meter contact!

tropospheric ducting. This is a regularly occurring condition in the Summer and Fall months when weather conditions enhance VHF and UHF range by as much as five to ten times the normal range. These conditions usually prevail between two long-distance points in the country where a high-pressure cell warms things up on the ground, creating hot muggy weather that may last for two or three days. During these periods, you can sometimes see a band of brown smoke hanging over the horizon, at an altitude of about 1,000 feet. The smoke is a good indication of an inversion layer.

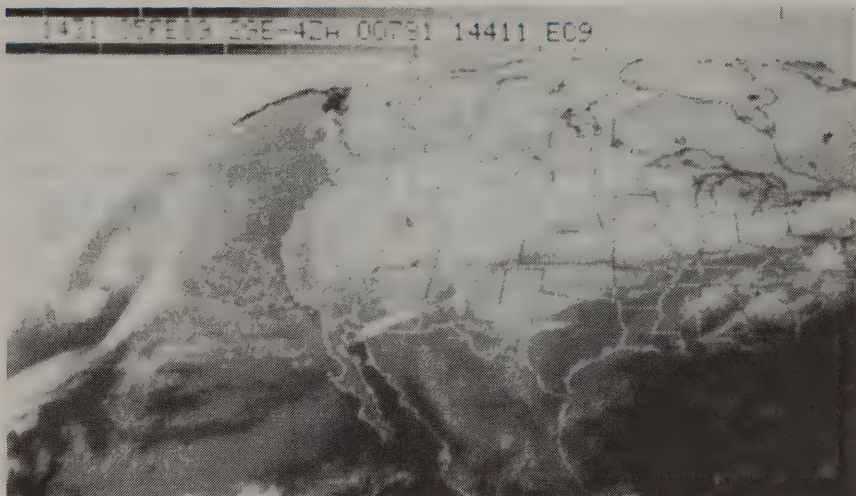
As high pressure sits over the United States, it compresses the air below, making it warm. Remember how hot the tire pump cylinder gets when you compress air inside of it. This band of warm air overlays cooler air below and creates a radio mirror or guide for VHF and UHF waves to travel along, for hundreds, sometimes thousands, of miles. It's the same principle of a mirage, but this time we're *below* the mirage, rather than above it.

Your 2-meter VHF waves travel up, and into, the tropospheric duct. The duct acts as a microwave wave guide, carrying your signal in the direction of a stable air mass. This effect allows you to sometimes access repeaters over 800 miles away!

Tropospheric-ducting conditions may also appear behind cold fronts, and in advance of warm fronts. This gives incredible long-range, 2-meter capabilities that might last over 24 hours.

This is the same condition that allows you to see, using an outside television antenna, distant TV stations coming in well beyond your normal, local TV-coverage range. Chances are you may have watched a television station 400 miles away on one of those hot muggy days where the temperature soared into the 90s, and there was hardly a breath of wind.

Tropospheric ducting has led to some interesting 2-meter contacts. The following can occur between 25-watt mobile-to-mobile, base-to-base,



Weather FAX computer programs will help spot tropo-ducting paths.

Tropospheric ducting has led to some interesting 2-meter contacts.

and sometimes even handheld-to-handheld stations separated by more than 500 miles:

- Boston to Miami for two days
- Chicago to Dallas, Texas for three days
- Texas to Florida, a regular summertime occurrence
- New York to Tennessee for over a week on and off
- Massachusetts to Puerto Rico for 22 hours
- California to Hawaii, a regular two-day summertime occurrence

The California/Hawaii summertime tropospheric duct is a common occurrence every August and September. Hawaii hams will work through Southern California repeaters for several days at a time. Some hams will drive to a Los Angeles mountaintop and talk direct using a regular 2-meter FM transceiver to Hawaii stations, located high atop the Mauna Loa volcano. There's nothing special here—just regular FM

transceivers, and mobile antennas, when conditions are great. When tropospheric-ducting conditions are "normal", the best long-distance transmission and reception is with a multi-mode 2-meter transceiver, using SSB down at 144.200 MHz.

Okay, here's your assignment:

1. Turn on your TV with an outside antenna.
2. Search the normally unused channels for distant activity.
3. Turn on your 2-meter transceiver, and tune in a frequency of a repeater 500 miles away. Do this every day.
4. Look at a newspaper weather map, and spot high-pressure cells, and stationary weather fronts.
5. Watch the television weather channel, and look for areas shaded in red as hot.

When you begin to see a distant picture on your TV set coming in, switch on your 2-meter transceiver. Use an ARRL repeater directory to locate distant repeaters. Try to work through that repeater, and see how far away you might communicate.

What is the farthest away you have communicated with *your 2-meter transceiver*? Write me, here at NARA, and we'll publish the results in an upcoming issue. Have you worked through a repeater more than 250 miles away? If you have, welcome to tropospheric ducting.

73 from Gordon, WB6NOA



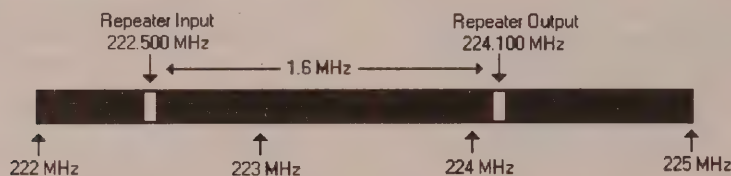
Questions About Repeaters That You've Wanted To Ask

by Phil Usher, KM6AA

WELCOME TO THE FASCINATING WORLD OF AMATEUR radio repeaters. As a new Amateur, you probably have a number of questions about these useful devices. Hopefully this article will answer most of them.

What is a Repeater?

A repeater is a device designed to automatically re-broadcast transmissions over a wider area than would be possible from the point of origin.



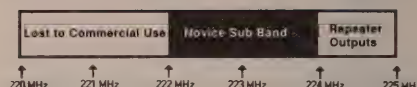
For example; without the help of a well-placed repeater, it would be unlikely for someone with a handheld 1.5-watt radio in Encino to talk with someone in Culver City.



In the VHF and UHF bands, location counts more than any other factor in determining communication distance. Communication is only effective a little further than line-of-sight. Therefore, the higher you place the antenna the greater its "field of vision." This is why mountain tops are favorite spots for repeaters.

What are the 222-MHz band privileges for an FCC licensed Amateur radio operator?

Originally the 220-MHz Amateur band ran from 220 MHz through to 225 MHz. Unfortunately, in August 1991 the FCC gave the bottom two MHz away for commercial use. This was a sad loss; Amateur activity in this section of the band consisted of SSB, weak signal, control links, digital and other experimental communication.



Note that Technicians can operate anywhere between 222 and 225 MHz but Novices are confined to a limited portion of the band. At first glance it would seem that Novice operators would not be able to use a repeater whose output frequency is above 224 MHz. However, there is no license required to listen. Most repeaters on the 222-MHz band receive 1.6 MHz below the output frequency. That places the repeater input inside the novice sub-band, therefore, Novice operators can use these repeaters.

What is repeater coordination?

In places where there are many Amateur operators, there are usually many repeaters. To prevent repeaters and repeater users from interfering with each other, there must be cooperation.

For the 222-MHz band in the Los Angeles area, a group called 220 Spectrum Management Association attempt to coordinate repeater frequency allocation. The 220 SMA allocate frequency pairs in such a way as to reduce the interference that their repeaters might cause to other coordinated repeaters.

What is a PL tone?

Los Angeles is one of the most densely populated areas in the world. This is certainly true when you consider the number of Amateur Radio

operators per square mile! As a result, you will find several repeaters will share the same frequency pair. There may be a Packet Digipeater or other voice repeaters in adjacent areas. Thus, there may be occasions when repeater users hear transmissions from both these stations.

To prevent users from accidentally keying more than just the target repeater, some repeaters incorporate a *Private Line system*.

A PL system expects a low-frequency tone to be on the incoming audio. Without this tone, a repeater will ignore the transmission. Because PL tones are at frequency of less than 250 Hz, small audio speakers aren't able to produce the sound and they go unnoticed. Therefore, PL tones are usually *sub-audible*. Actually if you had a speaker of suitably large diameter, you might hear the tone as a long bass sound like a hum.

What does Autopatch mean?

This is a device attached between the repeater and the commercial telephone network. It makes it possible for Amateurs to make telephone calls via their Amateur radio equipment.

The autopatch is only accessible with a specific sequence of DTMF tones on most repeaters. Usually only members are given the DTMF sequences for accessing the autopatch.

What is CTCSS or Tone Squelch?

These are two types of PL decoding systems available as options on most Amateur radios. Most repeaters don't rebroadcast the PL tone. Actually, most repeaters go to some lengths to remove all audio below about 200 Hz.

As mentioned earlier, a repeater may not be alone on its coordinated-frequency pair. Where temperature inversions occur, such as in southern California, it may be possible to hear the repeaters (even packet repeaters) from some distance. Packet transmissions are not much fun to listen to! Because of this, some repeaters may have encoded the PL tone into its transmissions. The repeater users can eliminate all un-

wanted stations by installing inexpensive CTCSS units into their radios.

Open, closed, private repeaters! What does this mean?

Open repeaters are available for use by all Amateurs without exception.

Closed repeaters require membership in the sponsoring group. Membership is, however, open to all interested Amateurs.

Private repeaters also require membership in the sponsoring group. However, membership is at the discretion of the repeater owner or existing-user group.

What do the noises that some repeaters make signify?

Just like any Amateur, the ten-minute identification rule also applies to repeaters. You will hear repeaters identify with either CW or with a synthesized voice. However, it is more common to hear a repeater identify in CW. Some repeaters use a mixture of voice and CW depending upon repeater activity.

If keyed after a long-idle period, the repeater will identify in a synthesized voice

that varies between natural and horrible. During normal conversation the repeater will identify with CW because

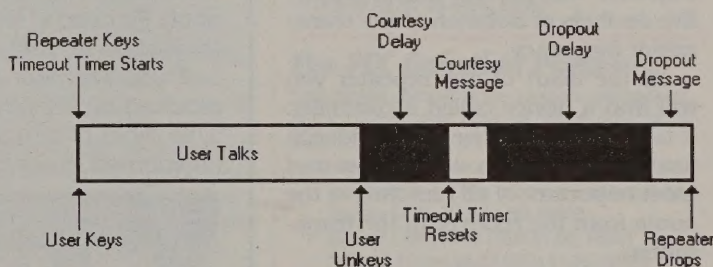
it is faster and less obtrusive in back of the conversation. When repeaters identify in CW they must send it at a speed of 20 WPM or less. You can often pick out more of the call sign than you would expect even if your code speed is very slow and here's how:

Almost all repeaters use the same format. The CW identification will begin with DE then the call sign followed by /R(repeater). You might be able to pick out a letter or two of the call sign. Once you have a couple of the letters, you might be able to

figure out which repeater you are listening to by looking at a repeater guide for one that has those letters.

It would be unfortunate if a failure caused a repeater to go into continuous transmission. It would also be against FCC rules! Therefore, in cases of error or failure, a repeater must prevent being stuck in perpetual transmit. Repeaters avoid this by using a clock that times the transmission length. After the timer expires the controller will shut off the transmitter. The duration of the time-out timer is an issue of personal preference and varies from one repeater to another. Repeaters rarely go off the air entirely following time-out, as the timer will reset after the signal being received stops transmitting. In other words, providing a person doesn't talk for too long the repeater will not time-out. Even if it does, it will probably come back up again. Typical time-outs are set for three minutes.

Most repeaters have the option to make a noise that signifies when the time-out timer has reset. This courtesy message means the next user may transmit. The courtesy beep is usually a tone sound.



Repeater users should wait for the courtesy tone before transmitting. This creates a short pause between transmissions allowing others to break into the conversation, and assures that the time-out timer has a chance to reset. Users are also encouraged to transmit before the drop message, as this prevents unnecessary relay wear in the transmitter and power amplifier.

Let's take a quick look at some repeater components.

Receiver/Transmitter - Repeaters

need to receive and transmit *at the same time*. Doing this requires the receiver and transmitter be separate devices. This allows them to operate independently.

Imagine two-identical radios with their antennas side-by-side. Take one and tune it to listen to something fairly weak. Now take the other and tune it to a frequency only 1.6 Mhz away and transmit. The chances are that the weak signal you have been receiving on the first radio is now suffering the effects of the transmissions from the second radio. What happened? The receiver in the first radio becomes overloaded by the transmissions of the second, making it less sensitive.

To stop this from happening, you need to isolate the transmissions from effecting the receiver. Repeaters achieve this isolation by passing the signals through a device called a *duplexer*. A duplexer consists of several fairly large and expensive canisters called *cavities*. Each cavity is tuned for a specific frequency and any other frequencies have a tough time passing through. This creates a very effective filter that will attenuate unwanted transmissions. A good duplexer will provide about eighty-five decibels of isolation at the transmitter frequency.

At the heart of any repeater you will find a device called a *controller*. It takes care of all the timing, identification, autopatch connection and most important of all handling of the audio from the receiver to the transmitter.

The Antenna System - A good duplexer allows a repeater to use a single antenna for both receive and transmit. More complex repeaters use multiple receivers and antennas wherein each receiver has its own antenna. Only the receiver with the strongest signal passes information to the controller. Receiver selection is a continuous process and during a



single transmission the chosen receiver may change several times.

If you look up at any high spot in a large city, you are almost certain to find a repeater pole with all sorts of antennas on it. When you see one, the chances are that there is probably an Amateur-repeater antenna amongst them. The diagram on the lower left is a fairly close facsimile of a repeater pole.

Repeater Operation

Many repeaters are operated by non-profit Amateur Radio organizations. They use membership fees to cover costs associated with repeater equipment, site rental and the repeater telephone. The association's directors and control operators receive no compensation for their time. Therefore, you can feel assured that all membership fees paid to the association support the repeater.

The SouthWest Repeater - A helping hand to new hams.

In 1987, the SouthWest Repeater Association's founding members felt there should be a repeater where beginners would be welcome. The founders wanted a place where Novice operators had privileges and selected the 220-MHz band.

Some four-years later, the commitment for providing a friendly environment for new Amateurs, holds true. This attitude has kept the group alive and fresh. Our repeater is a place where new Amateurs can meet and talk with each other, and with those more experienced.

We encourage beginners to enjoy their new hobby. If you make a mistake on our machine we will laugh with you, not at you.

73, Phil Usher, KM6AA



A Quarter Century of Teaching Amateur Radio

Les Taylor, WA0QIT, is celebrating his 25th year teaching Amateur Radio in the Duluth, Minnesota and Superior, Wisconsin area.

Les has tested more than 350 prospective hams or approximately 25 percent of the hams within a 25-mile radius of Duluth-Superior.

His station has always been open to students for a "hands-on" experience. Pictured in his ham shack is Les, WA0QIT, on the left, showing SSTV to his latest student, Ron Wood, KB9HKB.

If you live near Les or simply want to say thank you, he can be reached at: 123 South 65th Avenue West, Duluth, MN 55807, (218)624-2758. From all of us at NARA, we commend your efforts, Les, in adding newcomers to our ranks!



The Ham Radio
HANDBOOK

by W. W. Clegg, Jr.

THE COMPLETE GUIDE TO HAM RADIO
FOR THE BEGINNER AND THE EXPERIENCED OPERATOR

160 PAGES, 11x14 INCHES, \$4.95

ISBN 0-87316-111-1

Ham Radio Handbook is the most comprehensive and up-to-date guide to the hobby of ham radio. It covers everything you need to know to get started, from the basics of radio theory to the latest in amateur radio equipment and techniques. The book is written in a clear, easy-to-understand style, making it perfect for both beginners and experienced operators. It includes a wealth of information on the history of ham radio, the various modes of operation, and the many ways in which ham radio can be used for communication and recreation. The book is a must-have for anyone who is interested in the hobby of ham radio.

W. W. Clegg, Jr. is a well-known author and editor in the field of amateur radio. He has written many books and articles on the subject, and is a frequent speaker at ham radio conventions. His expertise and passion for the hobby are evident in his writing, making Ham Radio Handbook a valuable resource for anyone who is interested in the hobby.

By Donald L. Stoner, W6TNS, is the leading book for anyone wishing to earn the new code-free Technician license. Includes every question plus the multiple-choice answers.

A vintage poster with a black border. At the top, the text 'ALL ABOUT RADIO' is written in a stylized font, with 'ALL ABOUT' in yellow and 'RADIO' in large, bold, red letters. Below the text is a black and white photograph of a vintage microphone on a wooden crate. A sign on the crate reads 'We have the radio you need'. The background of the poster is a textured, light-colored surface.

This is the book that Don Stoner wishes he had written. Harry Helms, AA6FW, wrote this book in a manner that can be understood by everyone.

UPGRADE!

It's time to make your business more efficient. Upgrade your office with the latest in technology. From desktop computers to mobile devices, we have everything you need to stay ahead of the competition. Call today for a free consultation and see how we can help you upgrade your business.



UPGRADE!, by Donald L. Stoner, W6TNS, shows "no-code" hams how easy it is to upgrade to the Tech-Plus or General Class license!

**How to Get Started in
PACKET RADIO**

By Thomas H. Brown, W2VH

Author of *How to Get Started in Teletype*
and *How to Get Started in Telex*

McGraw-Hill

[illegible]

ATV Secrets For Aspiring ATV'ers, written by Henry Ruh, KB9FO, contains everything you wanted to know about Amateur Television (ATV).

Please make your check or money order made payable to: **National Amateur Radio Association**

Join the National Amateur Radio Association and receive ... *The Amateur Radio Communicator!*

Who Should Belong to the National Amateur Radio Association?

- Anyone interested in obtaining an Amateur Radio license
- New Amateur Radio operators of all classes
- Public and private school teachers who want to introduce their students to Amateur Radio
- Beginning Novice and Technician class Amateurs
- Elmers who want to assist beginners
- All Amateurs concerned about the future of the Amateur Radio Service

What Will You Gain when You Join NARA and Receive the Communicator?

- 1 Knowledge to help Novice and Technicians get the most from the Amateur Radio Service
- 2 You will help insure a solid future for the Amateur Radio Service and its frequencies
- 3 The knowledge that *you* will be helping others become involved in Amateur Radio.

*This means an exciting future for you as
an Amateur Radio operator!*

Here's What You'll Find in the Communicator!

- Help passing the Amateur Technician Class exam
- Erecting your first antenna, propagation and more
- Different types of Amateur communications
- The latest details on rules and regulations
- Repercussions that government regulation changes will have on the future of Amateur Radio
- The latest news on proposed changes to the Amateur Radio Service
- News of interest to Novice and Technician operators
- Help upgrading your license class
- News and developments of particular interest to Novice and Technician class hams
- Pictures and news about other Novice and Technicians
- Hot Tips - news you need as an Amateur

▶ NARA publishes the only ham magazine that addresses these subjects in a simple-to-understand manner.

What's NARA Doing?

The goals of NARA are to:

- Publicize Amateur Radio to the general public
 - Get more young people involved in our hobby
 - Prevent confiscation of Amateur spectrum and obtain additional allocations for Novices and Technicians
 - Represent the interests of Novice and Technician class operators
- ▶ Amateur Radio recently lost part of the 220-MHz band and, in some areas of the country, is in the process of *losing access* to another band (900 MHz).

NARA is striving to get more people involved in the Amateur Service so we can increase activity and retain our remaining Amateur bands.

When you join NARA, your membership dollars will be used to **further these goals**. Let's face it—with a membership cost of only \$10.00 per year, ***you won't find a better value in Amateur Radio!!!*** Join today! It's easy. Just complete the subscription form below and mail your check or money order. For the fastest service, call 1-800-GOT-2-HAM (1-800-468-2426) with your Visa or MasterCard number.

Yes!

NARA
NATIONAL AMATEUR RADIO ASSOCIATION
P.O. Box 598
Redmond, WA 98073-0598

I want to join NARA and receive my bimonthly subscription to *The Amateur Radio Communicator*.

- ☐ One year for \$10.00
- ☐ Two years for \$18.00
- ☐ Three years for \$25.00

(Please print _____ Form of Payment MC _____ VISA _____ Check _____)

Name _____ Call _____

Address _____

City _____

State _____ ZIP _____

MC/VISA _____ Expires _____

Signature _____

Please make your check or money order made payable to:
National Amateur Radio Association

 **NARA**
NATIONAL AMATEUR RADIO ASSOCIATION
P.O. Box 598
Redmond, WA 98073-0598

NONPROFIT ORG.
U.S. POSTAGE PAID
DALLAS, TX
PERMIT NO. 4258

MBR#1059 EXP:Nv/De 94
J. A. Maxwell
W6CF
P. O. Box 473
Redwood Estates CA 95044-0473